Lancashire & Yorkshire Railway.

Practical Questions

FOR

Enginemen and Firemen.

LOCOMOTIVE DEPARTMENT,
HORWICH,
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PREFACE.

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This book has been printed with the object of giving young firemen easy access to the knowledge which will be most useful to them in their future career as Enginemen.

IN THE SHED.

1. *Q.*—What are the first things an engineman should see to on taking charge of his engine in the shed, before going out for his train?

A.—He should examine the water gauges to see that there is a proper quantity of water in the boiler, and to make sure that the gauges are working correctly, and not shewing false water, try each tap separately. He should also see what pressure of steam there is, notice the state of the fire, and test the vacuum brake, which should readily create at least 18 inches.

2. *Q.*—If he finds anything wrong with the water, or that the engine is likely to be late in steam, what should he do?

A.—He should call the attention of the Foreman to the matter at once, as the responsibility of the shedman or steamriser ceases (so far as his engine is concerned) from the time the driver takes charge of her.

3. *Q.*—Before leaving the shed what else has a driver to do?

A.—He has to read the posted notices and examine his engine.

4. *Q.*—Describe how a driver should examine his engine?

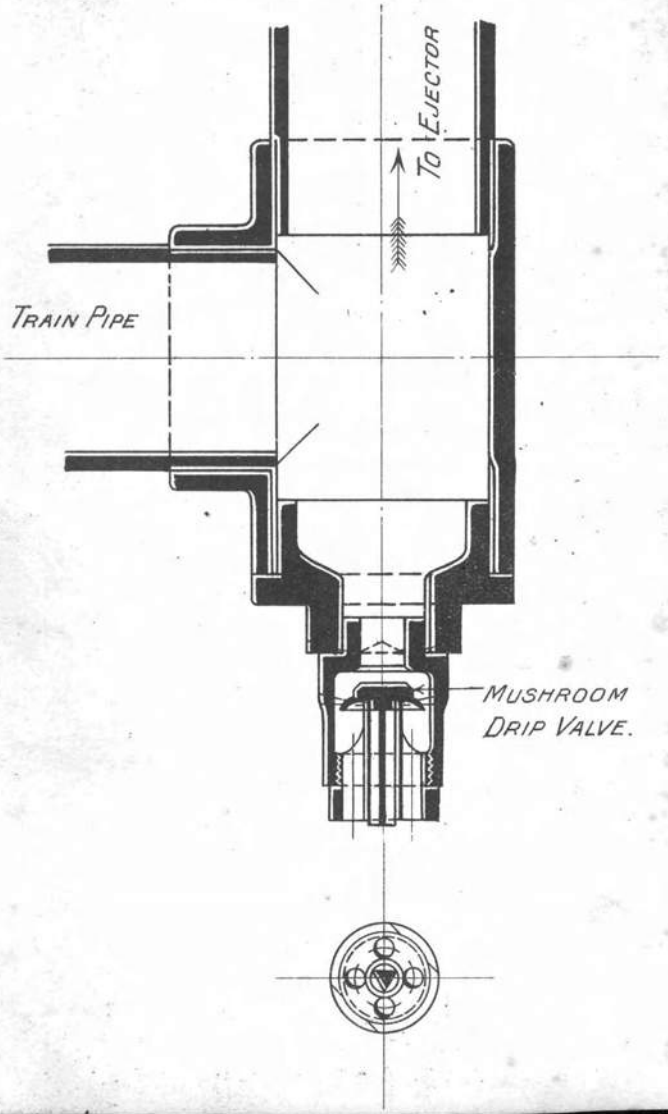
A.—He should take a hand hammer and begin at one particular place, going round the whole engine systematically. If he goes about from one part to another, he is liable to forget what he has examined, and what he has missed.

5. *Q.*—Suppose he commences at the leading end of the engine on his own side, how should he proceed?

A.—He should pass along from leading end of engine to trailing end of tender, then across the back, then along the fireman's side to the leading end, and then go under the engine; and should make it a rule to let nothing escape his notice.

6. *Q.*—What is the best position in which to set the engine before examining underneath?

A.—The engine should be set with both cranks down, that is, with one crank as much in front of the bottom centre as the other is behind it. The regulator must be shut, and the engine placed in middle gear, with the hand break on, and the cylinder cocks open.



7. *Q.*—What parts require special attention in examining an engine?

A.—The glands, all set bolts, big-end and eccentric bolts, all cotters, split pins, peg pins, and the vacuum brake gear. All motion pins should be tested by tapping them lightly, sideways, with the hand hammer.

8. *Q.*—What parts of the automatic brake fittings should the driver particularly examine?

A.—He should see that the couplings are properly fixed on the dummies or plugs by the fireman, look to the lubrication of the ejector disc, examine the drip valves, ball valves, and clappet valve.

9. *Q.*—Is it necessary to go underneath the tender, as part of the regular examination before leaving the shed?

A.—Yes, certainly; the brake gear, water scoop, water pipe connection and coupling between engine and tender, &c., should be examined.

10. *Q.*—How does the actuating cock of the water scoop work?

A.—To drop the scoop into the water, move the handle of the cock in the position

marked **"IN"** on the sector. To take the scoop out of the water, move the handle to the position marked **"OUT,"** leaving it there until sufficient time has elapsed to ensure the scoop being lifted, and then the handle must be placed to the central or running position.

11. *Q.*—Should the scoop be tested before leaving the shed?

A.—Yes, the scoop should be tested over the pit by lowering the mouthpiece, the bottom of which in its lowest position should be level with the top of the rails.

12. *Q.*—Describe how to set an engine so as to test the valves and pistons with steam to see if they are tight?

A.—Set the engine so that the two little ends stand level with each other, either at the front end of the slide bars or at the end next to the motion plate. When in this position if the lever be put in middle gear the valves will cover all ports, so that if steam be put on it will test the valves.

13. *Q.*—Is the same position of the engine right for testing pistons?

A.—Yes; then if the lever be put in full forward gear, the steam will be on one piston only; and if put into full back gear, the steam will be on the other piston only.

14. *Q.*—If the little ends are set level at the motion plate end of the bars, and steam be put on, which piston will it test in forward gear?

A.—It will test the right piston from the back. If put into back gear, it will test the left piston from the back. If the engine is then shifted a half turn, so as to bring the two little ends level with each other at the front end of bars, then the right piston will be tested from the front in forward gear, and the left piston from the front in back gear.

15. *Q.*—What is the difference between a plug trimming and a tail trimming?

A.—A plug trimming is one that only feeds when the engine is running, and is used for those parts that have sufficient motion to shake the oil over the end of syphon pipe, such as big ends and outside rods, &c. A tail trimming is always feeding (so long as there is oil in the cup), and is used for those parts of the engine which are steady, such as slide bar oil-cups, &c. A plug trimming is made by wrapping worsted over a piece of twisted wire in the usual way, and when in use the top of it should be a little below the top of syphon pipe. A tail trimming is made in the same way, but a few strands of worsted are left at the top

end, and these turn over and hang in the oil. All trimmings require to be looked at frequently, as they become clogged by the impurities in the oil.

16. *Q.*—Describe how to re-pack a gland?

A.—Set the engine so that the gland can be drawn clear of stuffing box, remove the nuts (placing them out of the way, and yet so that they can be got at when wanted), and draw back the gland; then clean out all the old packing, using a proper tool for this purpose. If any form of prepared packing is used, cut off as much as is required, wrap it round the rod and push it home into stuffing box with a packing tool. Notice where the first coil begins, and let the end of last coil finish at same place, or a little short of it, so as to have the same depth of packing all round the rod. Some patent packing is best put in in single rings, breaking joint.

17. *Q.*—What are the two most important things to attend to in screwing up a gland?

A.—To see that the gland stands fair with the rod, and to have the nuts well locked.

18. *Q.*—Is it necessary to screw glands up as tight as they will go?

A.—Not at all; so long as the packing is elastic and properly lubricated, screwing up with the fingers is almost sufficient; and any screwing up beyond what is enough to prevent blowing only makes the engine run stiff.

19. *Q.*—One engine will steam well, and another of the same class, and, to all appearance, exactly like it in every respect, will steam badly; what is frequently the cause of this?

A.—A slight difference in the set of the blast pipe with regard to the chimney will often account for this. The blast should be directed fair up the middle of the chimney; if at all on one side, the steaming quality will be affected.

20. *Q.*—What is the best way to see if the blast pipe is right in this respect?

A.—Get on the top of boiler and look into the chimney. If the black inside top of chimney presents the same appearance all round, the blast pipe is set fair; but if the black is fluffy on one side and scored on the other it shews that the blast pipe is directed to one side, that is, to the side which looks the most scored.

21. *Q.*—If a driver wants to clean the inside of a gauge-glass before putting it in, should he use an iron wire for the purpose?

A.—No; a piece of stick should be used; some gauge-glasses will break of themselves a few hours after being rubbed inside with an iron wire. Rubber washers will last longer if a turn or two of asbestos is inserted on either side. Care must be taken that the packing does not work under the bottom of the glass and thus block the water passage. If the thread on the gland is in good condition it should not be necessary to use anything on the nut but the fingers to tighten up the packing.

22. *Q.*—Is any care required in taking out the injector stop valve, or in taking the plugs out of gauge-cocks, &c.?

A.—Yes; care should be taken not to disfigure the brass or to bend or strain any part. If a driver finds that any of the fittings cannot be moved with reasonable force, he should get one of the shed fitters to it rather than put a piece of pipe on the spanner, and pull or hammer it till he breaks something. Nothing looks worse than battered brasses about the boiler front.

23. *Q.*—Mention some other points that a driver should see to before leaving the shed?

A.—He should make sure that he has a proper supply of coal, water, limestone or broken brick, and stores; that the sand-boxes are full, the ash-pan raked out, and the smoke-box empty and door properly shut; he must also see that the fireman is attending to his part of the work.

24. *Q.*—What are the fireman's duties on joining his engine in the shed?

A.—The fireman should try the water gauges and notice the pressure directly he gets on the foot-plate, and if he finds anything wrong with the water or state of the fire, should act as described in answer to Question 2. He should then unlock the boxes, and get out his shovel, oil cans, hand-brush, &c., and proceed at once to make up his fire.

25. *Q.*—How do you make up a fire?

A.—When the fireman comes on duty the fire should be fairly bright throughout the fire-box. The coal should be put on in lumps all round the walls of the box; it should be thickest under the door and in the back corners. No coal should be put in the middle of the box.

26. *Q.*—Some sorts of coal form a hard and close clinker on the fire bars. Can anything be done by the fireman to improve matters when working with this sort of coal?

A.—Yes; a very good plan is to scatter some limestone or broken brick (old arch bricks) over the bars before making up the fire. The bricks should be broken up into pieces rather smaller than a man's fist.

27. *Q.*—Having made up his fire, what should a fireman do next?

A.—He should go to the Stores for the oil, &c., clean up his foot-plate and boiler front, see that the sand-boxes are full, that the sand levers will work, that the sand is not damp, and do such oiling as the driver may entrust to him, taking care to clean out all dirt or water from the oil chambers. The tool boxes should be kept clear of all unnecessary articles and the tools kept in order.

28. *Q.*—May a clean foot-plate and boiler front be considered as indicating a driver who takes a pride in his work?

A.—Yes; of course the best foot-plate or boiler front will be more or less dirty after a hard trip, but when an engine fresh on duty

has a dirty boiler front and untidy foot-plate it is generally a sure sign of a slovenly driver and fireman.

29. *Q.*—Is there any harm in having weights on tank lids?

A.—These are unnecessary and must not be used. They prevent the free exit of the air when taking water, and when using the pick-up there is danger of the tank bursting or the weight being thrown off the engine.

ON THE ROAD.

30. *Q.*—What should a driver's first thought be when running?

A.—The safety of his train.

31. *Q.*—In what condition should the engine be before starting with a train?

A.—The fire should be well burned through, the boiler moderately full of water, the steam pressure near the blowing-off point, and all bearings oiled.

32. *Q.*—Do not some drivers fill up their boilers too full before starting?

A.—Yes, some men do this; but it is a great mistake, because when the regulator is opened the engine works the first few strokes with hot water instead of steam, and this takes all the lubrication off the valve faces and from the cylinders, making the engine work stiff, and preventing it from pulling more than about half what it would do if properly handled. It also prevents full vacuum being obtained at once, and is liable to burst the cylinder covers.

33. *Q.*—Is it a good thing to have the engine blowing-off hard when waiting for a train?

A.—No; this can be altogether avoided if the driver takes any care in the matter. The blow-back cock can be used, and the fire can be regulated; if *the dampers do not fit tight*, it is generally the driver's own fault for not booking them and getting them put right. All steam blown off through the safety valves is so much coal and water wasted.

34. *Q.*—Before starting what should a driver be careful about?

A.—He should see that his vacuum gauge is registering at least 18 inches in both the train pipe and chamber, that the train pipe is coupled between engine and train, that he gets the signal from the guard, and that the right signal is off for him to proceed. On single lines he must be specially careful that he has the proper staff or ticket to run over the section in advance. See Rule Book, Appendix I.

35. *Q.*—On starting a train, how should the steam be applied, and should it be shut off before pulling up the reversing gear?

A.—The regulator should be opened slightly until the train has got on the move, then opened to the full extent and the lever

pulled up as the engine gets up speed. The practice of shutting off steam to pull up the reversing gear, and then putting on steam again, is a bad one.

36. *Q.*—Is it a disadvantage to run with the regulator partly closed?

A.—Yes; to neglect to fully open the regulator means that the steam pressure in the steam chest is much less than it is in the boiler.

37. *Q.*—Is it necessary to pull the fire about with a pricker directly after starting?

A.—No, certainly not; it does the fire more harm than good, and is a sure sign that the fireman is not up to his work.

38. *Q.*—Is any care required about opening cylinder cocks?

A.—Yes; when the cocks are open the steam hangs about and hides the road (particularly in cold or damp weather), and so makes it dangerous for anyone walking on the ballast near the engine. More than one man has been run over owing to carelessness in opening cylinder cocks. The steam also condenses on the rails and makes the engine slip. It is better to open the cocks when backing to the train than when starting.

39. *Q.*—Do you know how to keep the steam chest and cylinders warm when having to wait some time for a train?

A.—Yes; this can be done by putting on the brake and opening the cocks, then opening the regulator very slightly, just sufficient to let a breath of steam blow through but not enough to raise a cloud of steam about the buffer plank.

40. *Q.*—What is most necessary to enable a fire to burn?

A.—Air.

41. *Q.*—How is smoke nuisance to be avoided?

A.—By producing a complete combustion of the gases in the fire-box.

42. *Q.*—If, when standing, there is smoke issuing from the chimney, what should be done?

A.—Put the jet on, open the fire-hole door and damper door slightly.

43. *Q.*—Why?

A.—Because the fire requires more air in order to burn the unconsumed carbon which was being wasted up the chimney.

44. *Q.*—Why, then, should not the fire-hole door be opened wide?

A.—Because if that were done, the cold air would be allowed a free passage to the tube-plate and in all probability cause the tubes to leak, besides doing damage to the fire-box in general by causing a sudden contraction of certain portions of it.

45. *Q.*—Then why open the fire-hole door slightly?

A.—The fire-hole door is fitted with a baffler, and when open slightly this deflects the air on to the gases in the fire-box.

46. *Q.*—What is the effect of the jet?

A.—The jet when blowing steam up the chimney carries out with it the air from the smoke-box, creating a partial vacuum there, and this induces a draught of air through the ash-pan door and fire-bars into the fire-box, where it mingles with the gases and causes a better combustion.

47. *Q.*—Has the blast-pipe a similar effect on the fire?

A.—Yes, only a greater one; the blast-pipe and chimney are equivalent to the cones of an enlarged ejector and create more vacuum in the smoke-box than the jet will; This is why, if the blast-pipe is not set true, there is not a sufficient supply of air distributed amongst the gases in the fire-box, and consequently the fire does not burn as brightly, therefore less steam.

48. *Q.*—What should be the condition of the fire while running?

A.—The fire should be concave; that is, it should be solid all round the sides of the box, particularly in the corners and under the door, and thin in the middle. In all engines the aim should be to keep the fire thickest along the back of the box, that is, under the door. The tube plate should be kept clean.

49. *Q.*—When firing, where should the coal be put?

A.—The coal should be put on in regular order, beginning at one particular place each time, and working round the box. With sloping fire-boxes the coal should never be thrown towards the front of the box.

50. *Q.*—Why is it best to fire in regular rotation, as described in the last answer?

A.—Because if this is not done the fireman gets into the habit of firing first one part of the box and then another, and the result is that the fire gets too thick in some parts and too thin in others.

51. *Q.*—Should any coal be put into the middle of the box?

A.—No; that part of the fire will take care of itself.

52. *Q.*—Should a train engine be fired when standing at a station?

A.—No; train engines should only be fired when running, and with the steam on.

53. *Q.*—Where an engine is standing pilot, or in the case of a shunting engine, it is sometimes necessary to fire while the engine is standing; how do you manage this so as to prevent smoke?

A.—By firing round the sides of the box and leaving a large part of the middle of the fire bright, and by not putting too much on at once.

54. *Q.*—How should the fire be managed towards the end of the run, or when finishing the day's work?

A.—The driver should be able to judge when there is enough fire on to finish with, and the fire should be levelled and pushed into the corners as it burns down; if a little more steam is wanted, a shovelful or two of small coal can be scattered over the box.

55. *Q.*—Is it a good plan to rake the ashes off the top of the brick arch just before finishing?

A.—Yes; this should always be done (where the construction of the arch will admit of it); if the ashes are left on the arch it helps to make the tubes leak, particularly when any of them are inclined to do so.

56. *Q.*—Need the driver or fireman go out on to the framing or back of the tender when running?

A.—No; this practice is always attended with danger, and is hardly ever necessary. If the motion will not easily run for 50 miles without looking at, it is a sign that something is wrong with the engine or that the driver is nervous. It should be quite unnecessary for the

fireman to go on to the back of the tender as the water gauge shows the water level, and even if the gauge is out of order the pressure from the tap will give a very fair indication as to the quantity in the tank.

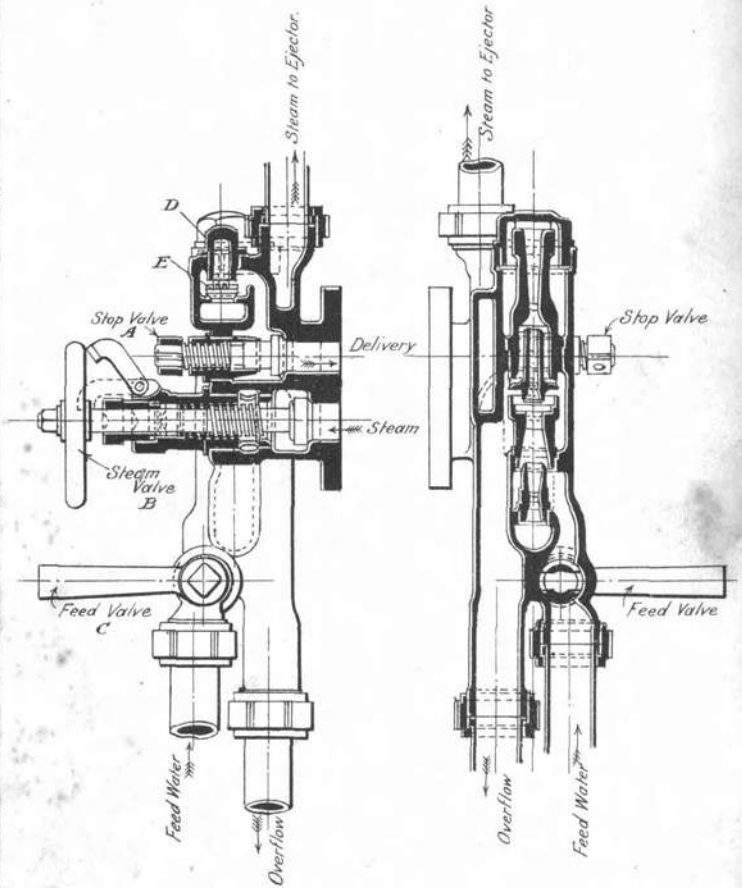
57. *Q.*—What is the best way to work an injector?

A.—The injector should be set to supply about as much water as the engine is using so as to be kept pretty constantly at work; this is important on long runs. If an injector has been shut off, it should not be put on just before firing, but the engine should be fired first, and the injector put on afterwards. Each injector should be used in turn so that both will be kept in good working order. In case the water pipes become heated, the hot water can be drawn off by means of the ash-degger.

58. *Q.*—In working a stopping train (particularly if it is a light train) the injector cannot always be kept on, what is the best way to work then?

A.—Arrange matters so as to have the injector on when steam is shut off to stop, and while at the station; shut it off just before starting, and fire between stations.

NOTE.—If Injector blows back, shut stop valve **A**, steam valve **B** and feed valve **C**, then unscrew casing cap **D**, take out back pressure valve **E**, and clean carefully both valve and seating.



59. *Q.*—Most injectors are difficult to start if the top clack sticks or blows back; do you know of any injectors which have a provision against this?

A.—Yes; injectors that have a stop valve over the top clack can be shut off if the clack should blow back.

60. *Q.*—Then is it possible to start these injectors when the clack is blowing badly?

A.—Yes, quite; in fact these injectors could be worked without any top clack at all.

61. *Q.*—How would you manage this?

A.—If the clack blows, close the stop valve over the clack (this will stop all blow back), and then proceed to start the injector as usual; as soon as you hear it take the water, open the stop valve by hand, and the injector is at work.

62. *Q.*—Supposing that the injector blows back or past the back pressure valve, what should be done?

A.—See sketch. Shut off stop valve A, steam valve B, and feed valve C, then unscrew casing cap D, take out back pressure valve E,

and clean carefully both valve and seating. This operation should not take more than two minutes.

63. *Q.*—What difference is there between the right and the left hand injector?

A.—The left hand injector has an extra union on the top to supply steam to the combination ejector for vacuum automatic brake.

64. *Q.*—Should a driver look back when running?

A.—Yes; he should look back now and then on the journey to see that his train is all right. When starting, the fireman should always look back on the platform side till the last vehicle gets clear of the station. See Rule 172*b*.

65. *Q.*—When approaching a signal which appears doubtful, or which from any cause cannot be distinctly seen in good time, what should a driver do?

A.—He should at once treat the signal as though it stood at danger, and act accordingly until it is distinctly seen to be all right. See Rule 74.

66. *Q.*—Should there be any hesitation about this?

A.—No; safety is more important than time, and it is a driver's clear duty to lose time rather than run the slightest risk.

67. *Q.*—Should a driver report all cases of defective signals at the end of his day's work?

A.—Yes, and the attention of the staff on the spot should be called to the defect wherever possible; if all drivers made a point of attending to this, there would not be many cases of lamps being out and signals working badly.

68. *Q.*—Is it a driver's duty to report anything which he may notice in the state of the road or bridges, &c.?

A.—Yes; by doing this he may be the means of preventing an accident.

69. *Q.*—Is it possible to notice any difference between a careful driver and a slovenly one in the simple matter of putting an engine on a turntable or stopping opposite a water column?

A.—Yes, quite; the man who has his wits about him knows exactly where to stop on the table or at the column, having noticed what

part of his engine comes opposite a certain part of the table or platform, as the case may be; he is thus able to stop quietly and easily, just at the right place. The engine should be taken slowly on to the turntable, and care should be exercised in applying the brake, as otherwise the table may be seriously strained.

70. *Q.*—At the end of a day's work should a driver leave his engine without examining it?

A.—No, he should examine the engine to see if any repairs are wanted before next trip.

71. *Q.*—What should a driver attend to after finishing his trip, before leaving the shed?

A.—He should enter any repairs required to his engine or tender in the repair book, look at the running sheet to see what turn he is on for next day, and if anything unusual has occurred on the journey he should leave a report of it at the shed office before he goes home. If he has been relieved he should draw the special attention of the reliefman to any defect in the engine.

72. *Q.*—How does the vacuum passenger communication operate?

A.—The communication is made by pulling a chain which passes along the inside of the carriages. This opens a small valve and allows air to enter the train pipe; at the same time a red disc fixed on to the end of the coach is turned from a horizontal to a vertical position so as to be visible to the driver and guard. The valve is sufficiently large to drop the vacuum about 10in. and cause the brake to go on. See Rules 3*a* and 3*b* in Appendix XI. to Rule Book.

ENGINE BREAKDOWNS.

73. *Q.*—If an engine breaks down from any cause, while running, what should the driver do?

A.—He should stop at once in order to see what is wrong, and then, if possible, get the engine into working order, so as to take the train forward with as little delay as possible.

74. *Q.*—Mention a few of the principal causes of engine failures on the road?

A.—Burst tube, broken coupling rod, broken connecting rod, broken eccentric rod, broken piston rod, cotters working out of big end, little end, or valve spindle, motion pins working out, big or little end running hot, broken tyre, broken crank axle, defect in vacuum brake.

75. *Q.*—When a tube bursts what is the right thing to do?

A.—When the tube bursts, put on both injectors, and if you can manage to get under the protection of signals before you stop, so much the better. The water will generally damp the fire sufficiently, but if the burst is near the smoke-box, the bulk of the water may go that way, and the driver must be prepared to pull the fire out and damp it if necessary.

76. *Q.*—If the plugs blow under full steam pressure, is it advisable to try and tighten them?

A.—No; not under steam. Remember that the full boiler pressure is at the back of the plug, and the hammering may cause it to blow out. This also applies to wash-out plugs, which must not be screwed up under steam.

77. *Q.*—In the case of a broken coupling rod what should be done?

A.—After taking down the pieces of the broken rod, the corresponding rod on the other side of the engine must also be taken down; if

this is neglected, the rod will be doubled up and broken before the engine has run very far. When about to uncouple any part of the engine, it is a good thing to take your bucket down; this does to carry nuts, washers, pins, or tools, instead of laying them about the ballast.

78. *Q.*—Describe what to do when anything breaks between the piston and the crank, such as a piston rod, or connecting rod, or big or little-end strap?

A.—When any of these break, the right thing to do is to uncouple and work one side. Thus suppose the right little-end strap to be broken, take down the connecting rod and disconnect the right valve. If there is an intermediate valve spindle or pulling link which can be got out, that is generally the quickest and best way to disconnect the valve; but if this cannot be done, the eccentric rods on right side must be taken down. Then set the valve in the middle of its travel (this will cover all ports), and lock it there by screwing up one gland nut, so as to twist the gland on the spindle and cramp it. Where the gland is packed with U.S. packing, a clip to go round the valve spindle and fit on to one of the gland studs will

be required. Having done this, pick up the parts of the motion and put them on the tender, whistle for the guard (if he has gone back), and then start the train. In many cases of failure of Joy's motion, such as a bent connecting rod, &c., it will only be necessary to uncouple the big end and the valve spindle, fix the valve in central position and the piston at one end of the cylinder, and securely fasten up the connecting rod clear of the crank circle.

79. *Q.*—Is it always necessary to lock the piston in a case such as described above?

A.—No; this is not always necessary, because when a breakage takes place between the crank and piston (such as a piston rod, connecting rod, big or little end straps, or bolts, or cotters), the piston is suddenly released and generally breaks through the front cover and sticks there; but if the front cover is not broken, then it would be necessary to lock the piston in order to prevent it shifting and breaking either cylinder cover in the event of any steam getting past the valve.

80. *Q.*—How do you lock the piston?

A.—Push it up to one end of the cylinder and then put a piece of wood between the slide blocks and end of the slide bars, and tie it there, so as to secure the cross-head and piston. It is generally better to pull the cross-head out as far as it will come, and then put the blocking in between the cylinder cover and back of the slide-blocks.

81. *Q.*—How can you tell whether the valve is properly set so as to cover all three ports?

A.—By putting on a little steam; if it blows badly the valve is not right and must be shifted either further in or out. A thoughtful driver will always have in his tool-box a small piece of iron or wood cut to the right length, so that by putting it against the steam chest and noticing where the back of the valve-spindle cross-head comes when in the middle of its stroke, he will be able to set the valve right at once on the darkest night. It does not take long to prepare such a gauge for any engine when the valves are being examined, and no driver should be without one.

82. *Q.*—Is there any reason why an engine should not be run at full speed when working only one side?

A.—No; of course an engine working one side is only half as strong as she was before; but there is no reason why she should not be put well over and made to work as hard as possible.

83, *Q.*—If a valve spindle gets bent or doubled up so that the valve cannot be shifted, what is to be done then?

A.—Uncouple that side of the engine (as described before), and notice whether the valve-spindle stands *out* or *in*, then lock the piston with the rod either *out* or *in*, the same as the valve-spindle stands. Thus, if the valve-spindle is *out*, the front port is uncovered, then pull the cross-head *out* as far towards the motion-plate as it will go, and lock the piston there by putting a piece of wood between the cylinder cover and the slide blocks.

84. *Q.*—If an eccentric rod breaks, what can be done?

A.—If a back gear rod breaks, the engine can be run in forward gear without taking down anything but the broken rod. Or, if a forward-gear rod breaks, the engine can be run in back gear by simply taking off the broken rod. But

if required to be run forward with a broken fore-gear rod, the engine must be uncoupled on that side as described above.

85. *Q.*—If the regulator becomes uncoupled, so that steam cannot be shut off, is it necessary to stop and give up the train?

A.—No; the engine can be worked with the reversing gear by putting it into middle gear or partly into back gear when about to stop.

86. *Q.*—If the reversing lever or any part of the gear breaks, so as to let the engine fly into full gear, what should be done?

A.—The engine can be worked by easing the steam with the regulator.

87. *Q.*—What is the best thing to do in case of a broken tyre?

A.—Do not attempt to work the train forward, send for another engine, and if possible work the disabled engine slowly to the nearest point where it can be put clear of the main line.

88. *Q.*—When an engine or tender has been re-railed after having been off the road, what things should a driver be especially careful about?

A.—He should in all cases have the Wheels gauged, no matter whether the run off has been an easy one or not; he should see that his springs and pins and hangers are all right, and that no bits of iron packing have been left about the axle boxes. Where his tender boxes are lubricated from below, he should take off the doors and see that the brasses are right, and that the packing has not been flattened down by the journal dropping in the box when the wheel was off.

89. *Q.*—When a driver has to wire for assistance in consequence of a breakdown, or from any other cause, what should he bear in mind in writing his telegram?

A.—He should remember that the man to whom he is telegraphing knows nothing about the case, and that therefore the telegram should be as clear as possible. If his engine is off the road he should say how many wheels are off, and give the position of engine, whether foul of

either main line, &c., and generally give any information which will be of use to those sending assistance.

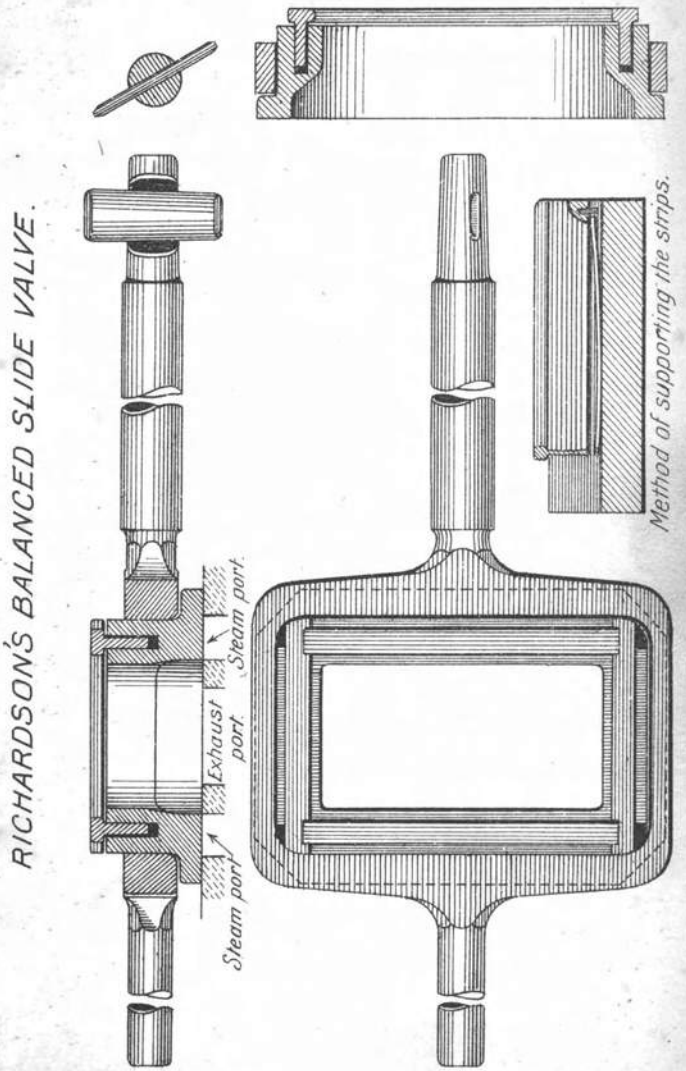
90. *Q.*—What could be the cause of the vacuum piston sticking?

A.—If it is frosty weather it will probably be due to the ball valve being frozen fast. This can very soon be released with the aid of a little fire. If the rolling ring has become twisted and thus jammed the piston, knock out the pin coupling the piston rod to brake lever.

91. *Q.*—Is special care required when uncoupling engines fitted with Richardson's valves?

A.—Yes; when uncoupling one side after breakdown care must be taken, if the valves are of the above type, that the valve spindle is not pushed in either direction beyond its usual travel, or the strips inside the steam chest will get over the edge of the rubbing plate and fasten the valve.

92. *Q.*—Should the regulator be closed when running down inclines?



A.—No; particularly with fast trains it is advisable to keep a breath of steam on, otherwise the valves and pistons will not get sufficient lubrication.

93. *Q.*—What would you do in the case of a broken spring?

A.—If a spring breaks or is lost on the road, more particularly if it is a leading one, the safe running of the engine may be insured by lifting the affected end with the screw jack and placing a suitable piece of packing between the axle box and engine framing.

94. *Q.*—What is to be done with a broken crank axle?

A.—This is invariably a job for the Tool Van, but if it is a question of being able to move the engine out of the way, if the wheels could be lifted clear this may be done with the assistance of another engine by first packing between top of leading and trailing axle boxes, then after slacking off the springs on the broken axle, place wedge-shaped piece of wood or iron on the rails against the wheels of the broken

axle, draw the engine on to the wedges, and pack between the bottom of the axle boxes and the horn stays, the wheels will then be clear of the rails and the engine movable.

95. *Q.*—What would you do in case of the water pickup breaking?

A.—If the balance weight is broken off and no further damage done, the train may be worked to a convenient stopping place by running with the pickup actuating valve in the out position. If the damage is more extensive, the broken parts must be taken down or made secure before proceeding. Damage to the vacuum connections of the pickup will not affect the brake so long as the actuating handle is kept in the middle position.

96. *Q.*—Are these all the cases of breakdowns that may happen to an engine?

A.—No; engines may fail from many causes other than those mentioned, and drivers should consider what action they would take in the event of other failures which they think might be likely to occur.

AUTOMATIC VACUUM BRAKE.

THE ACTION of the automatic vacuum brake is, briefly, as follows:—

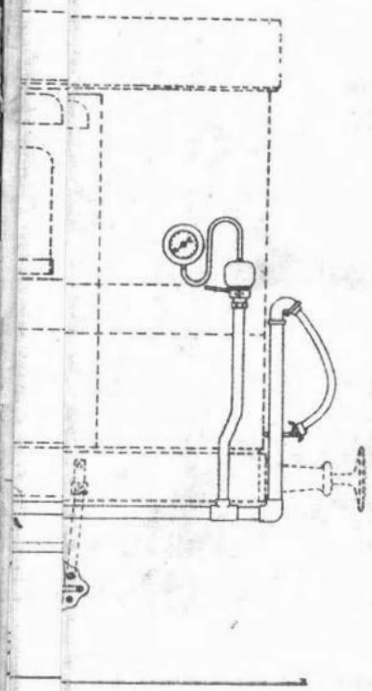
Vacuum, which may be defined as space void of air, is created in the train pipe, and on both sides of the pistons or diaphragms in the brake cylinders, by either of the ejectors in the combination box, or by the pump on engines so fitted. The brake is applied by moving the application valve handle to the "On" position; this admits air to the train pipe and to the bottom side of the pistons or diaphragms, but the air is prevented from going to the top side by the ball valve which is forced to its seating and closes the passage.

As there is vacuum on the top side of the piston, and the bottom side is open to the air, the pressure of the air forces the piston upwards and thus pulls the brake blocks on to the wheels. To release the brake the application valve is moved to the "Running position" if the small ejector is used, or to the "Off" position if the large ejector is used, and the air that has been admitted is extracted again, thus allowing the brakes to fall off.

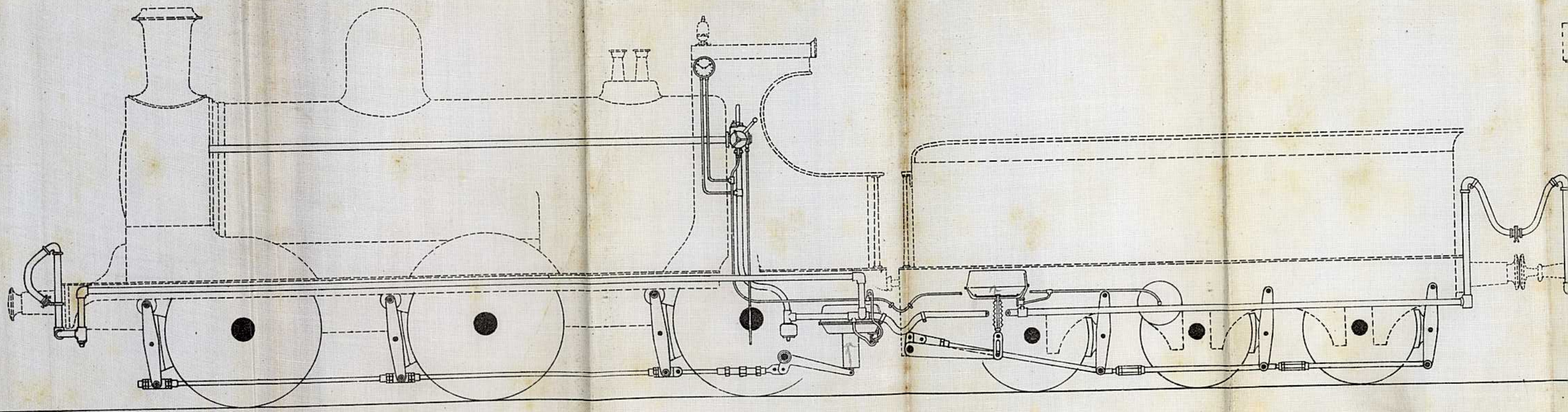
To Test the Engine Brake for Leakage.—First blow the vacuum up, then shut off both ejectors and note whether the gauge shows any leakage, then apply the brake. If the chamber side finger drops steadily to zero instead of remaining at about 15 inches, the defect may be due to the following causes:—Dirt under ball valve; hole in the diaphragm; damaged rolling ring; or leakage in the small pipes leading to the top side of the cylinder, reservoir, or water pickup actuating valve. If the brake does not leak off after application, but does before, examine the drip valves, clappet valve, application valve stockings, or piston rod bush, train pipe, and pipes to bottom side of cylinder.

When making the examination take a piece of lighted tar band, as a leakage will show itself by drawing in the flame.

If it is evident that there is a hole in one of the diaphragms, but it is not clear as to which, each can be tried separately by inserting a piece of tin or a blank joint between the joint of the ball valve casting and the cylinder.



THE VACUUM AUTOMATIC BRAKE.



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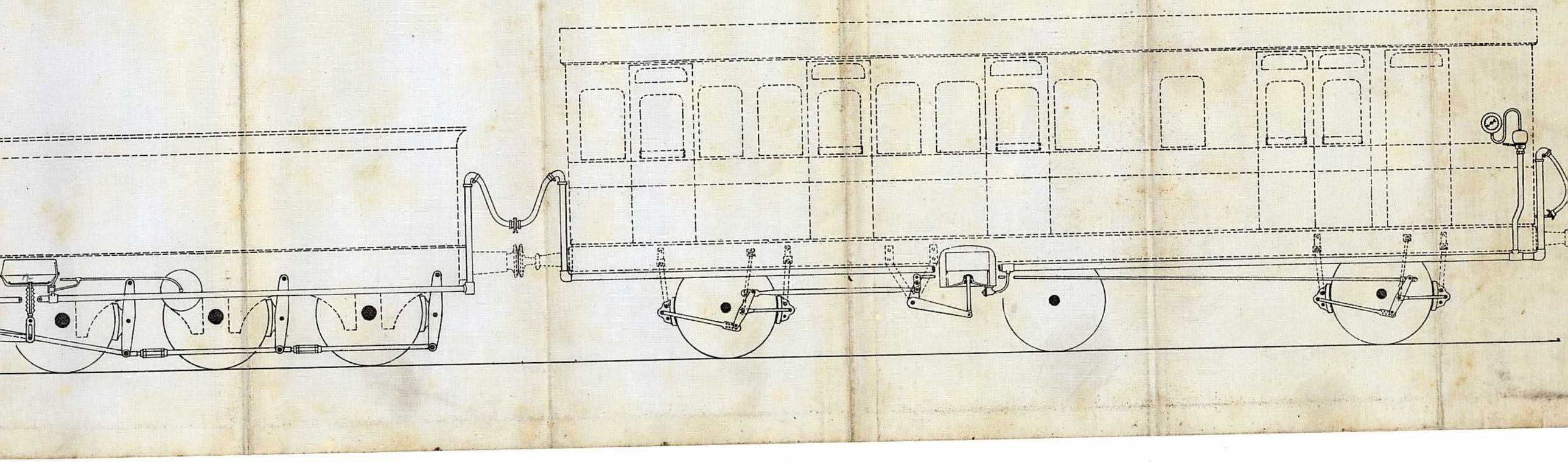

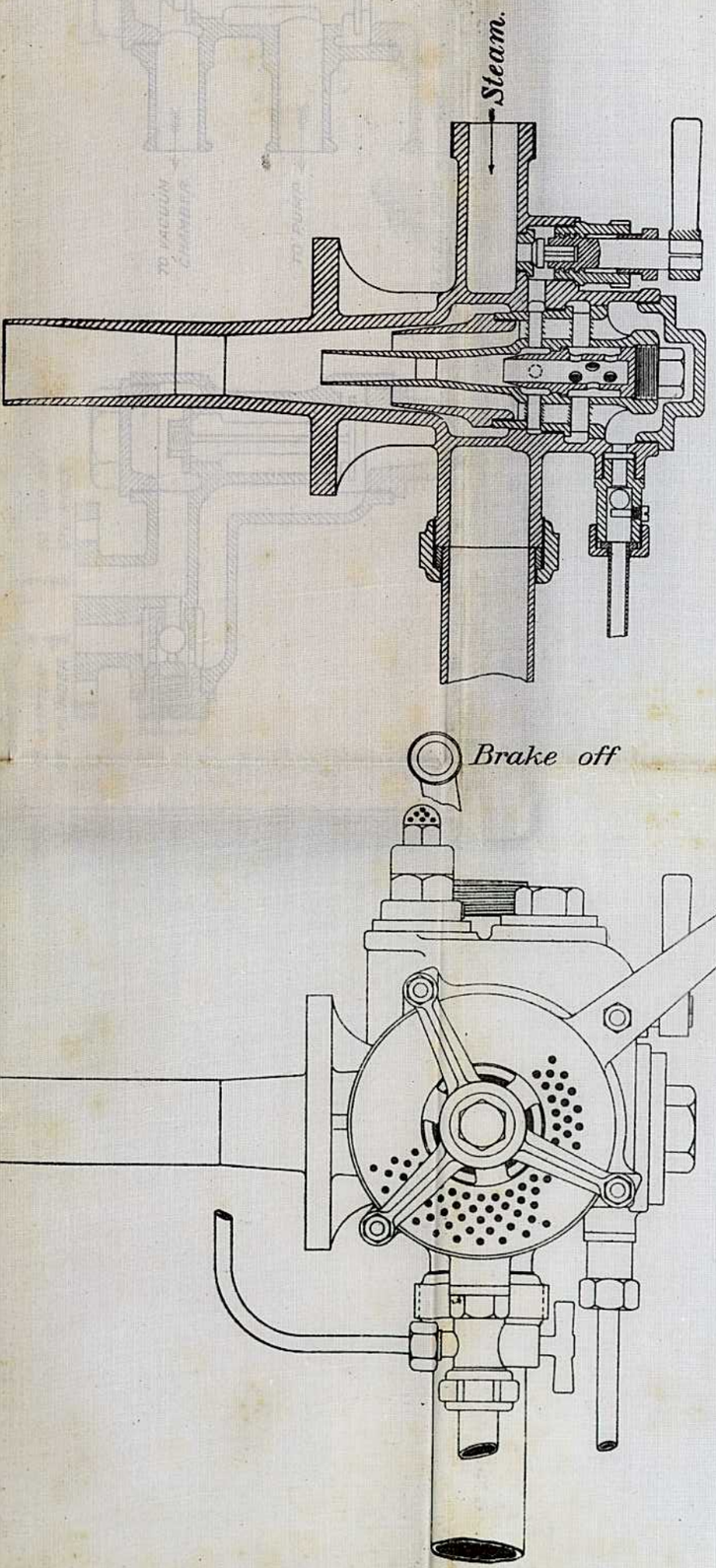

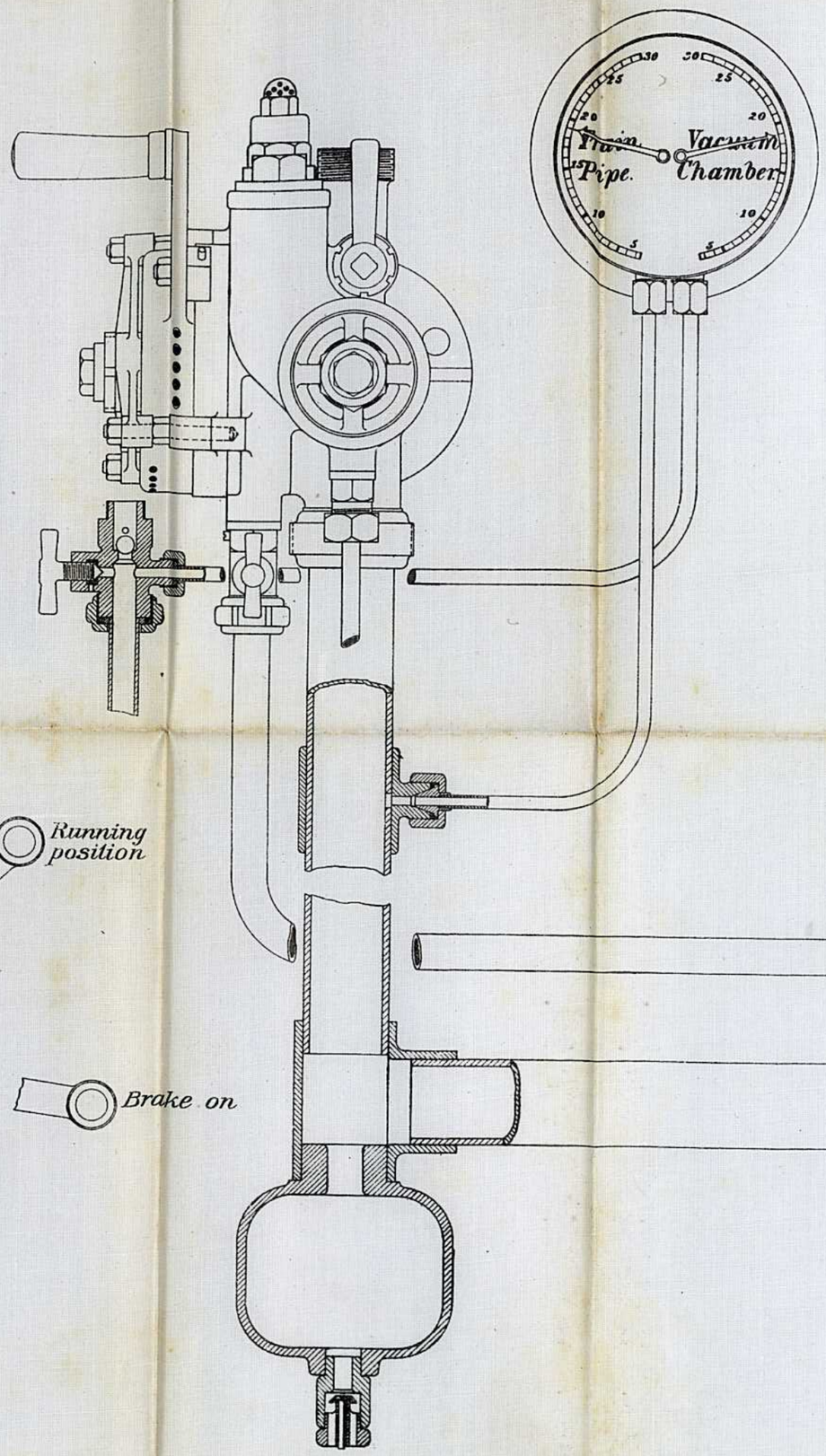

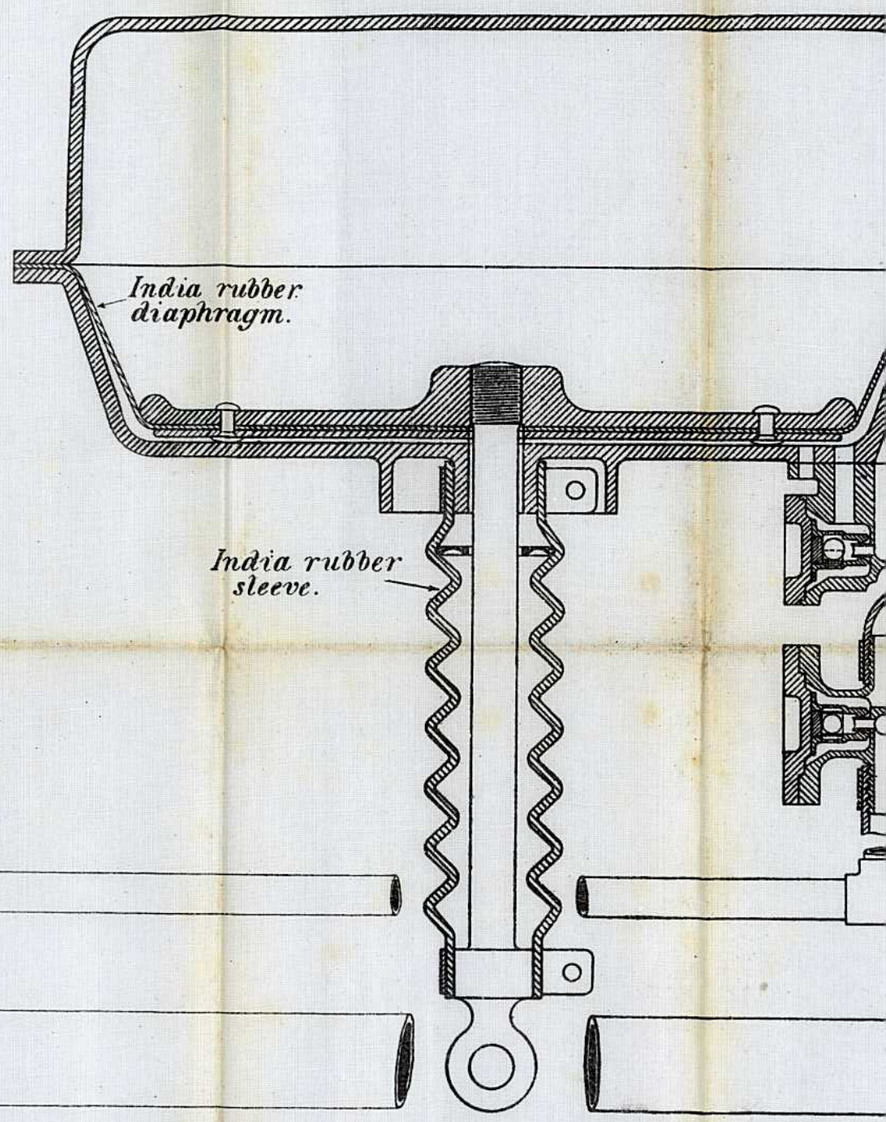

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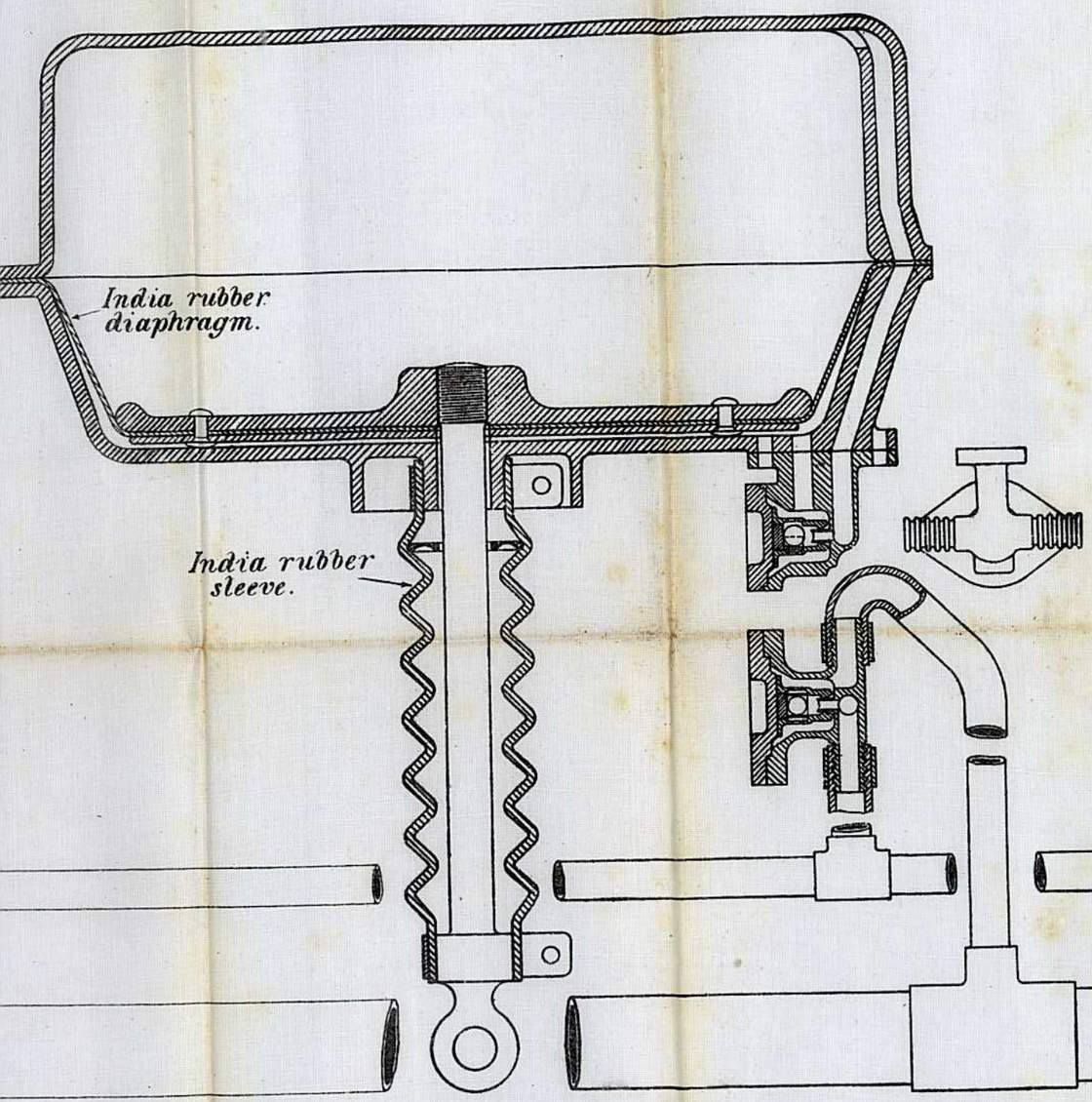

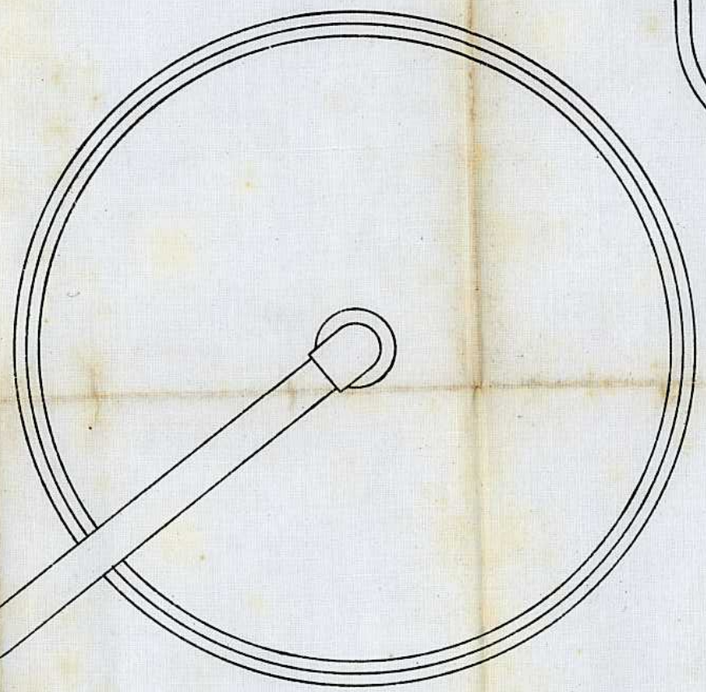

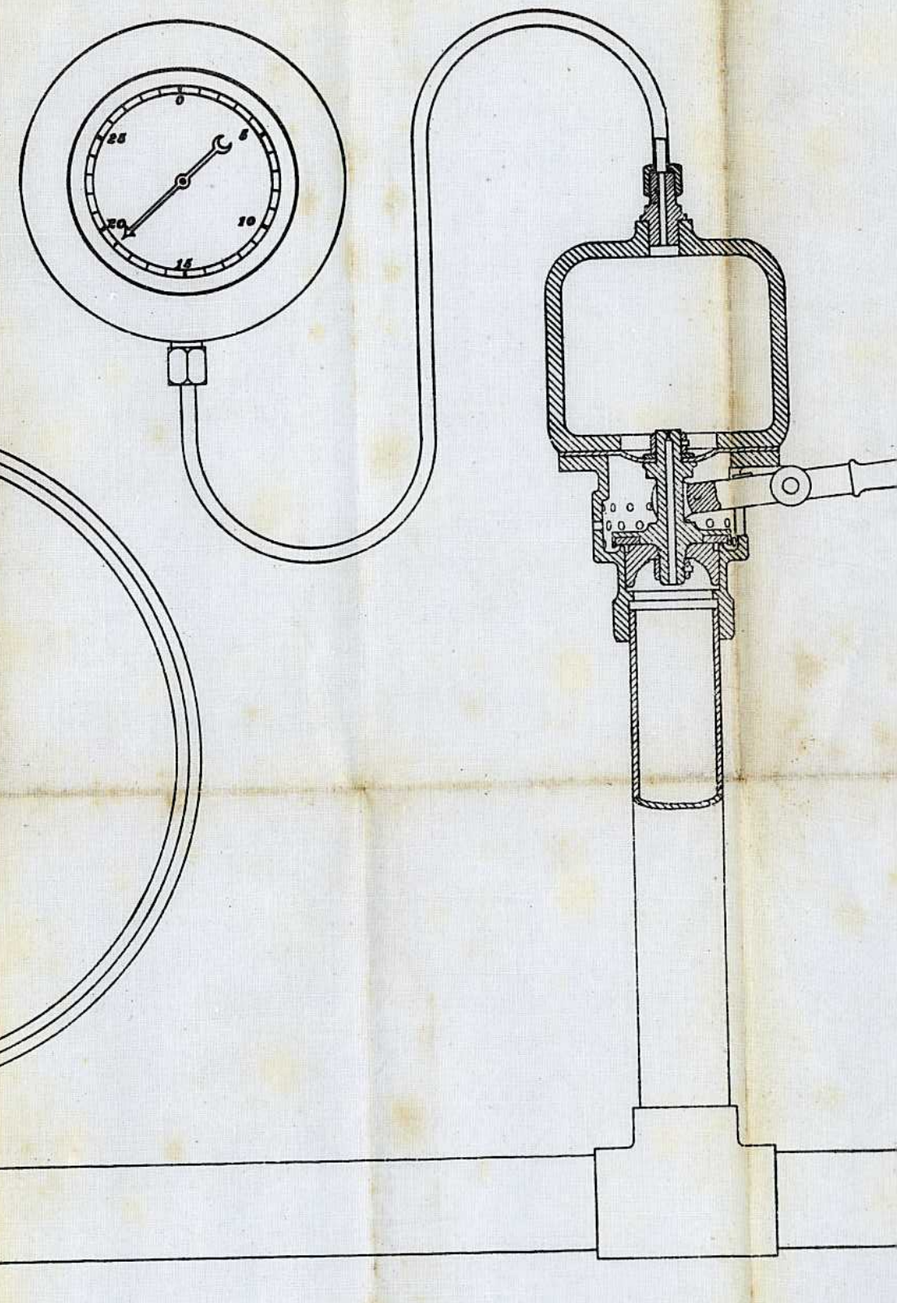

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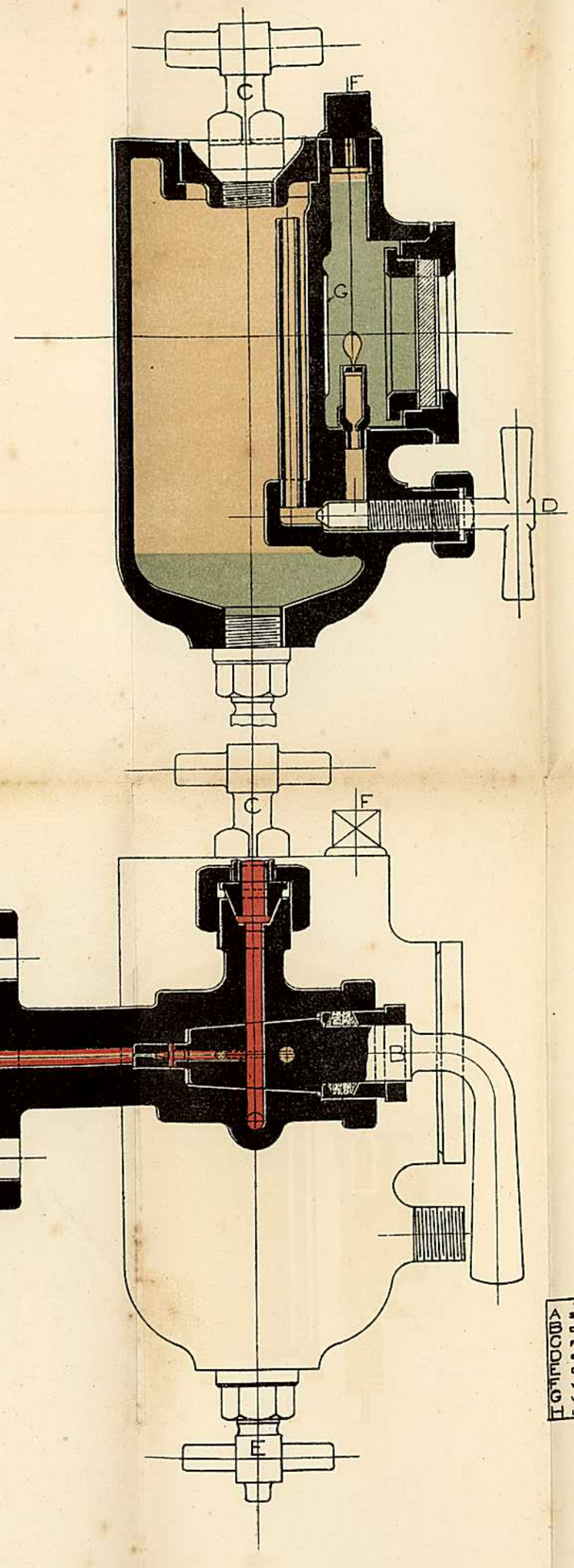
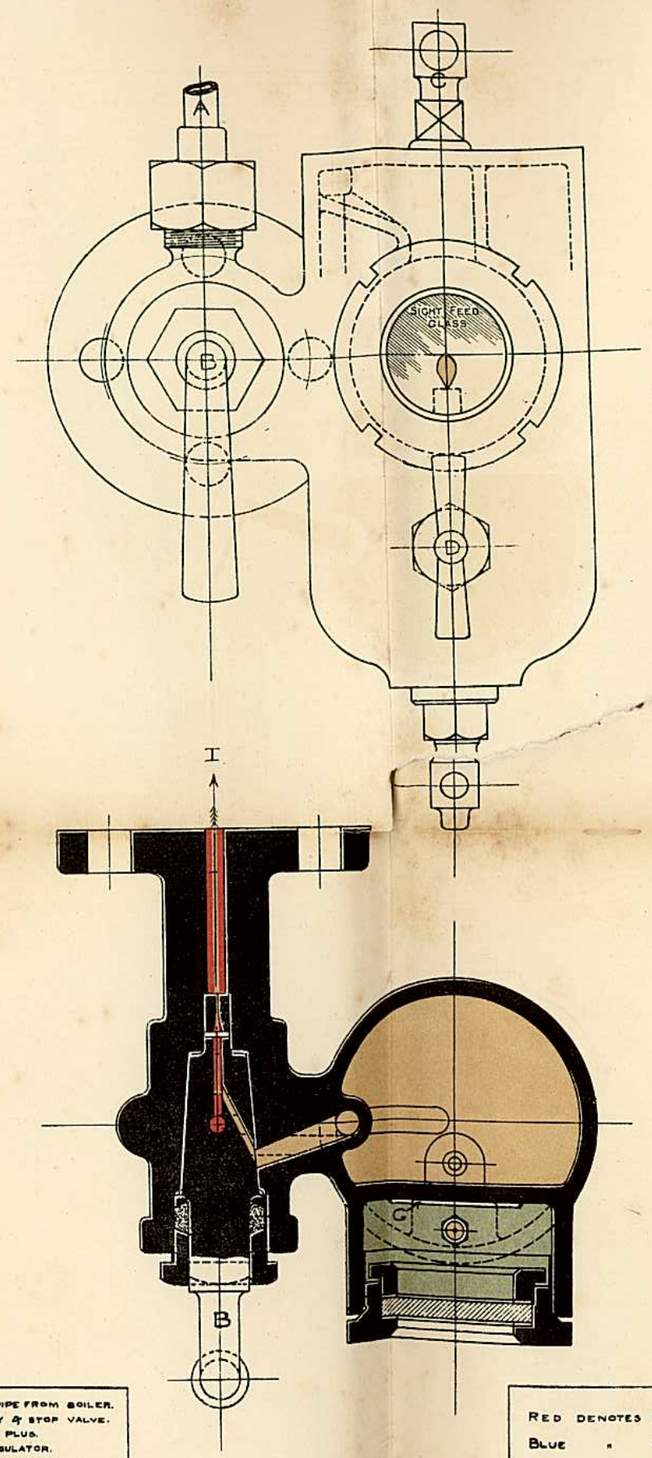
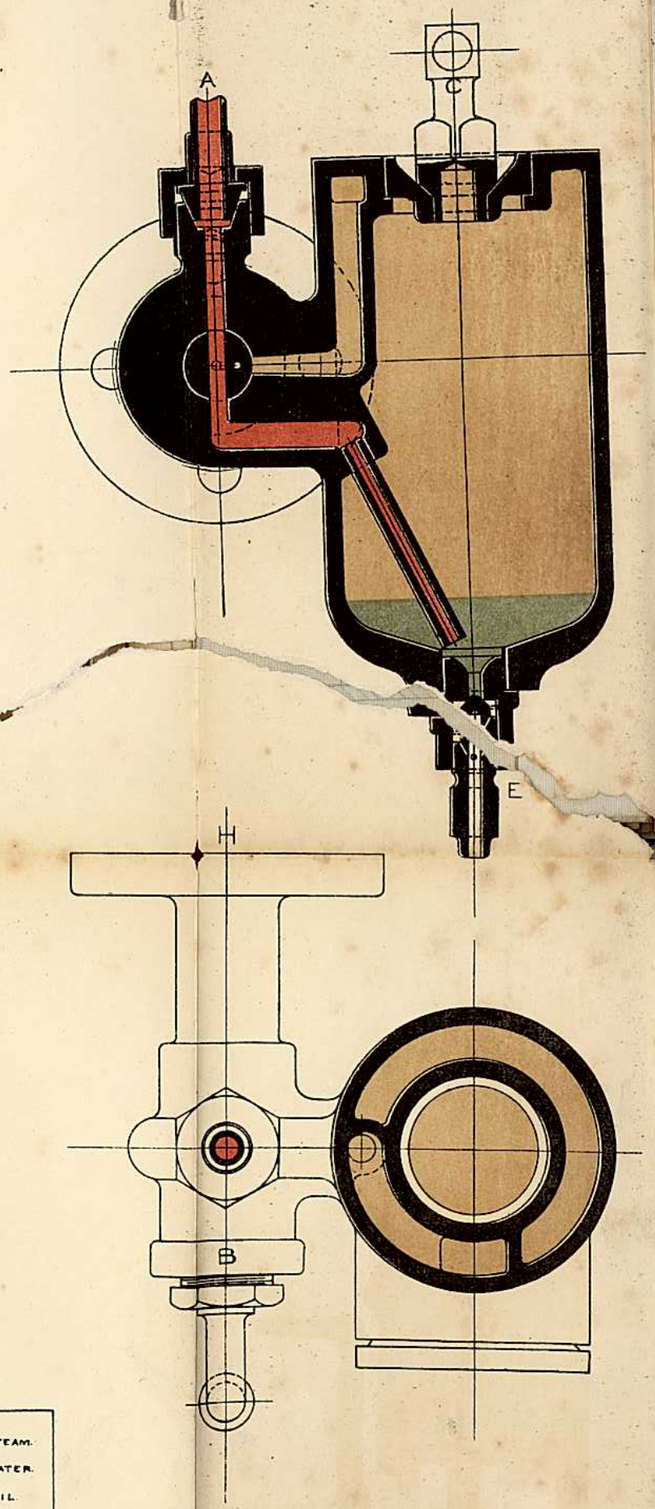




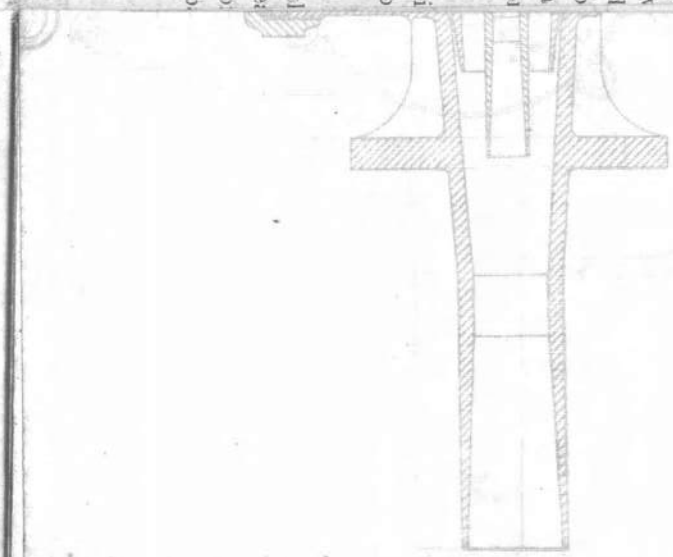


A	STEAM PIPE FROM BOILER.
B	DELIVERY & STOP VALVE.
C	FILLING PLUG.
D	OIL REGULATOR.
E	DRAIN VALVE.
F	WASH-OUT PLUG.
G	WHITE ENAMEL DISC.
H	DELIVERY TO STEAM CHEST.

RED	DENOTES	STEAM.
BLUE	"	WATER.
BROWN	"	OIL.

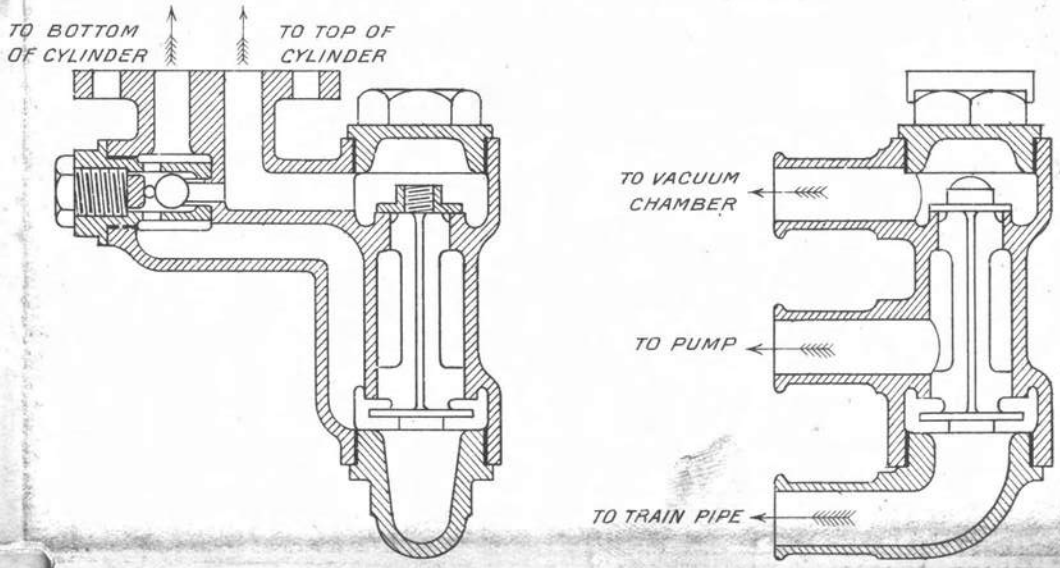
ACTION OF THE SIGHT FEED LUBRICATOR.

DRAWING Nº 10088.
DRAWER Nº 151.

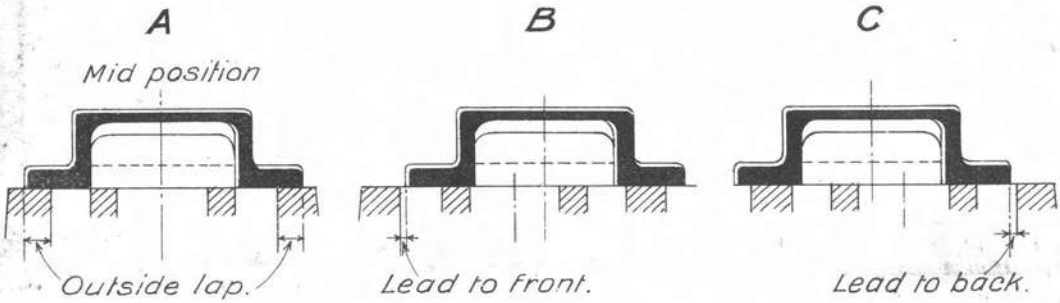


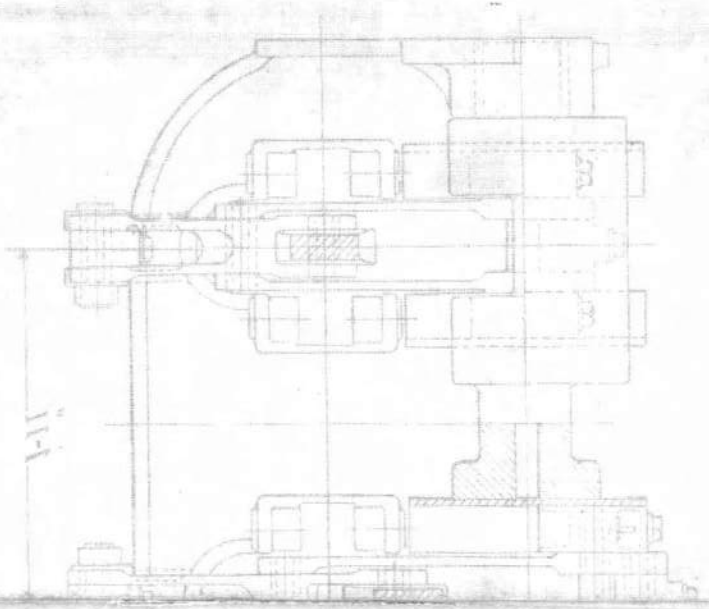
AUXILIARY BALL VALVE,

FOR USE WITH SINGLE CONE EJECTORS.

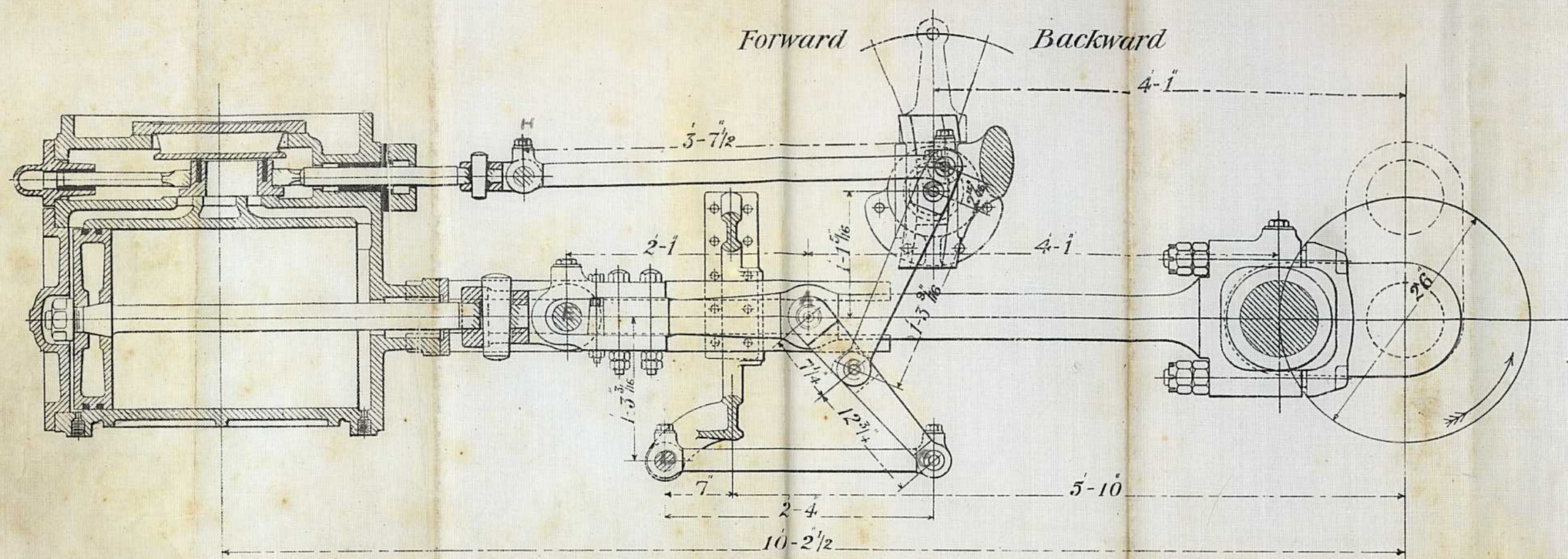


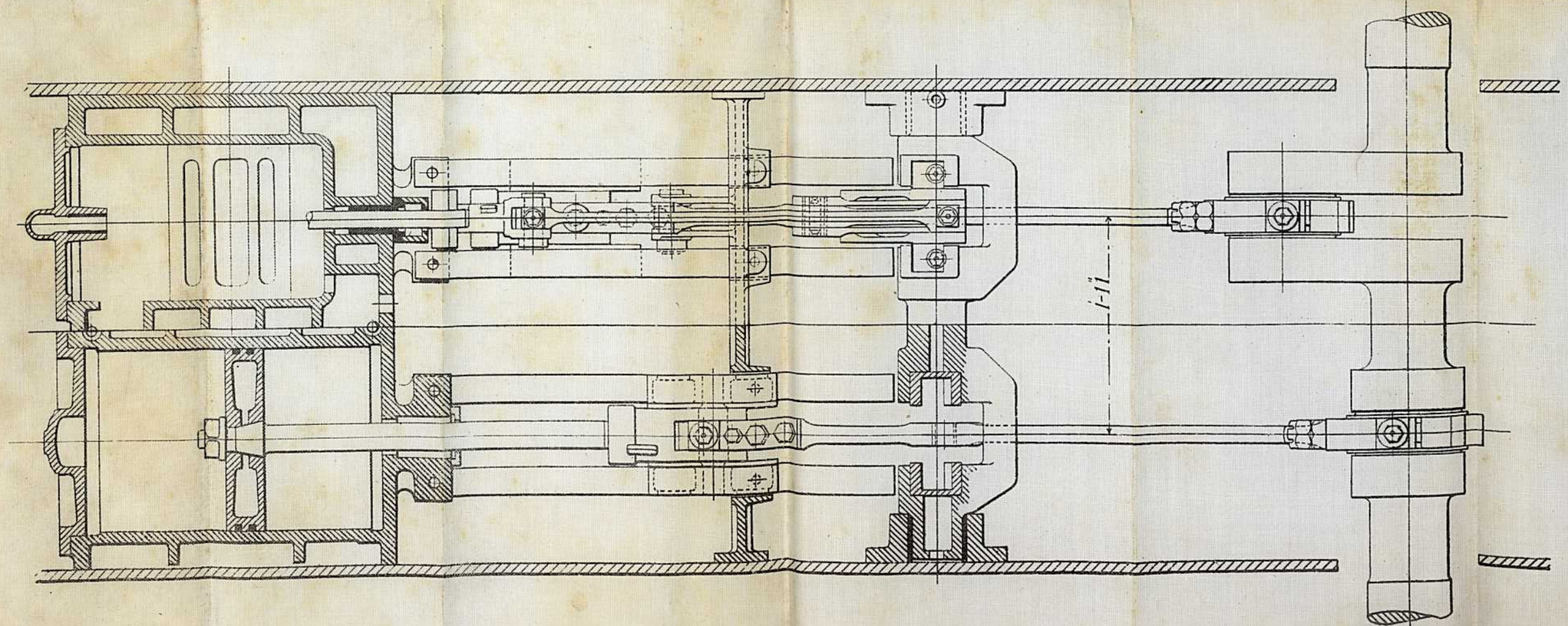
Diagrams of Slide Valve showing Lap and Lead





JOY'S VALVE MOTION.





DESCRIPTION OF LAP AND LEAD OF SLIDE VALVES.

LAP.—The slide valves control the admission, expansion, and release of the steam in the cylinders. The slide valve diagram represents the different positions of a valve over the ports. In Fig. A the valve is shown in the middle of its travel, in which position it covers all the ports.

The portion of the valve overlapping the outer edges of the steam ports on either side when in the middle position is called the "Outside Lap."

Outside lap is given so as to close the steam port before the piston has reached the termination of its outward stroke, and thus use the steam shut up in the cylinders expansively. By utilising the expansive property of steam a considerable saving of fuel and water is effected.

A further advantage is also gained when the engine has started, in screwing or notching up the reversing gear, which decreases the valve travel. By this operation the steam ports are reduced in opening, lessening the supply of steam to the cylinders, and allowing a longer period of the piston movement for expansion.

Lead.—Figs. B and C. Before the Piston reaches the end of its stroke, the slide valve, which is moving in the opposite direction, opens the steam port and allows a charge of steam to get behind the piston. This steam acts as a cushion to the reciprocating parts, and prevents the engine from pounding. When the piston has completed its stroke, the valve has opened the steam port a certain amount. This opening is called the "lead." The amount of "lead" given to locomotives is usually about $\frac{3}{16}$in. It will be observed that to obtain the proper amount of lead, the valve must travel considerably in advance of the piston; in link motion this is adjusted by setting the engine with the piston at the end of the cylinder, then turning the eccentric tumbler round in advance of the crank till the valve opens $\frac{1}{8}$in. or whatever lead is required. In "Joy's" motion the lead depends upon the lengths of the links and cannot be altered after the engine is erected.

TABLE TO CALCULATE THE SPEED OF TRAINS.

Speed per Hour	Time occupied per Mile		Time occupied per ¼ Mile		Speed per Hour	Time occupied per Mile		Time occupied per ¼ Mile		Speed per Hour	Time occupied per Mile		Time occupied per ¼ Mile	
Miles	Mts.	Sec.	Mts.	Sec.	Miles	Mts.	Sec.	Mts.	Sec.	Miles	Mts.	Sec.	Mts.	Sec.
60	1	0	0	15	31	1	56	0	29	17	3	32	0	53
56	1	4	0	16	30	2	0	0	30	16	3	44	0	56
53	1	8	0	17	29	2	4	0	31	15	4	0	1	0
50	1	12	0	18	28	2	8	0	32	14	4	16	1	4
47	1	16	0	19	27	2	12	0	33	13	4	36	1	9
45	1	20	0	20	26	2	20	0	35	12	5	0	1	15
43	1	24	0	21	25	2	24	0	36	11	5	28	1	22
41	1	28	0	22	24	2	28	0	37	10	6	0	1	30
39	1	32	0	23	23	2	36	0	39	9	6	40	1	40
37	1	36	0	24	22	2	44	0	41	8	7	28	1	52
36	1	40	0	25	21	2	52	0	43	7	8	32	2	8
35	1	44	0	26	20	3	0	0	45	6	10	0	2	30
33	1	48	0	27	19	3	8	0	47	5	12	0	3	0
32	1	52	0	28	18	3	20	0	50	...	...	...	...	...

900 divided by the number of seconds occupied by a Train travelling between any two Quarter-mile Posts will give the average speed of the Train in miles per hour.